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List of Abbreviations

AF	acre-foot
AFY	acre-foot per year
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CRWQCB	California Regional Water Quality Control Board, San Diego Region
DFG	State of California Department of Fish and Game
DHS	State of California Department of Health Services
DWR	State of California Department of Water Resources
ENR	Engineering News Record
EPA	United States Environmental Protection Agency
gpd	gallons per day
gpm	gallons per minute
hp	horsepower
mgd	million gallons per day
lin. ft.	linear foot
MCL	maximum contaminant level
mg/l	milligram per liter
MTBE	methyl tertiary butyl ether
MVGDP	Mission Valley Groundwater Desalter Project
MWD	Metropolitan Water District of Southern California
O&M	operation and maintenance
SDCWA	San Diego County Water Authority
SWA	Sweetwater Authority
TDS	total dissolved solids
µg/l	microgram per liter
USFWS	United Stated Fish and Wildlife Service
USGS	United States Geological Survey

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PROPOSED TIME SCHEDULE ORDER

CALIFORNIA REGIONAL WATER QUAILTY CONTROL BOARD
SAN DIEGO REGION

KINDER MORGAN ENERGY PARTNERS, LP o/p SFPP, LP,
POWERINE OIL COMPANY,
SANTA FE PACIFIC PIPELINE PARTNERS, LP, SHELL OIL COMPANY,
TEXACO REFINING AND MARKETING, INC., EQUILON ENTERPRISES LLC,
EXXONMOBIL OIL CORPORATION

MISSION VALLEY TERMINAL
9950 & 9966 SAN DIEGO MISSION ROAD
SAN DIEGO COUNTY

The California Regional Water Quality Control Board, San Diego Region (Regional Board) finds that:

1. Kinder Morgan Energy Partners, LP o/p SFPP (KM), LP Santa Fe Pacific Pipeline Partners, LP, Shell Oil Company, Texaco Refining and Marketing, Inc., Equilon Enterprises, LLC, ExxonMobil Corporation (collectively Dischargers)were required to clean up and abate the effects of an unauthorized discharge of petroleum hydrocarbon waste to soil and groundwater underlying the Mission Valley terminal bulk storage facility and off-site areas by January 1, 1999, pursuant to Cleanup and Abatement Order (CAO) No. 92-01, as amended in 1994 by Addendum No. 1.

2. The Dischargers failed to achieve full immobilization of dissolved phase petroleum as required by CAO No. 92-01 Directive No. 2.

3. The Dischargers' failure to comply with CAO No. 92-01 as amended constitutes a continuing violation of CAO No. 92-01.

4. As a result of the Dischargers' failure to comply with the CAO, extensive subsurface fuel contamination has spread off-site under Friar's Road, San Diego Mission Road, under the City-owned Qualcomm Stadium property, and beyond.

5. Consequently, it is now necessary to expedite off-site cleanup at the Mission Valley Terminal so that the groundwater resource development planned by the City of San Diego can be fully commissioned by September 1, 2007, which will be 15 years after the issuance of the first CAO.

6. Further, given the age of Qualcomm Stadium and ongoing discussions with the primary leaseholder, the City is currently planning to redevelop the Qualcomm Stadium Property and cannot freely do so until the extensive fuel contamination is remediated.

7. Current estimates of the volume of LNAPL range from 70,000 to 100,000 gallons of LNAPL. Thus, the remediation time estimates in the KM Summary Report (January 30, 2004) are highly uncertain.

8. Pursuant to the Opinion and Award issued by Judge Robert Altman in the Matter of the Arbitration Between SFPP/Kinder Morgan v. Texaco and Shell, the Court concluded that Kinder Morgan was the sole cause of the Core Plume, as described in that Opinion and Award, emanating from the MVT onto the Qualcomm Stadium property and beyond. Further, the Court concluded KM/SFPP was obligated to conduct all remediation of the soil and groundwater contamination, and to comply with all Regional Board orders relating to that remediation, at and under the Qualcomm property and beyond that to all locations the soil and groundwater contamination had spread. That Opinion and Award was confirmed on October 31, 2003, by the Los Angeles County Superior Court in the Judgment in *Texaco Refining and Marketing Inc., et al. v. SFPP LP, et al.,* Case Number BS083707.

9. No term or condition of CAO No. 92-01, as amended, is superceded by this Time Schedule Order. The terms and conditions of CAO No. 92-01 shall remain in full force and effect.

10. The issuance of this Time Schedule Order is an enforcement action taken by a regulatory agency and is exempt from certain provisions of the California Environmental Quality Act (CEQA) in accordance with section 15321, Chapter 3, Title 14 of the California Code of Regulations.

IT IS HEREBY ORDERED, that pursuant to sections 13267 and 13308 of the California Water Code, KINDER MORGAN ENERGY PARTNERS, LP o/p SFPP, LP, shall:

1. Immediately begin negotiating access rights to the Qualcomm Stadium Parking Lot with the City of San Diego such that KM can expeditiously conduct additional field work at the site.
2. Quantitatively map the spatial distribution of the LNAPL retained in off-site soils by September 1, 2004, so that the volume of LNAPL is known with greater confidence.
3. Immediately identify and investigate the potential for accumulation of gasoline vapors in subsurface utilities and within adjacent permeable fill materials in the City right-of-ways between Mission Valley Terminal and Qualcomm Stadium. The results of the investigation shall be provided by September 1, 2004. Should IDLH conditions (immediately dangerous to life or health) be identified during the investigation, KM shall immediately notify the City and RWQCB and implement corrective measures.

4. Re-commission and expand KM's air-sparging system and install a network of soil-vapor monitors by September 1, 2004 after discussions with the Board's own consultant, Dr. Paul Johnson, as to their location.

5. Install a barrier wall and appropriate on-site, up-gradient extraction wells at the MVT by January 1, 2005, to ensure that no further migration of LNAPL occurs from the Terminal itself.

6. Remediate groundwater impacted by fuel products in all offsite areas downgradient of the Mission Valley Terminal by September 1, 2007. Groundwater shall meet or exceed MCLs for fuel components, including but not limited to benzene and MTBE, by this date.

7. Undertake pilot testing of KM's soil-vapor extraction system to improve the effectiveness of the SVE wells in removing the LNAPL from the vadose zone of the contaminated off-site areas (e.g., to determine the number of pore volumes of air required to remove LNAPL without by-passing LNAPL in low-permeability zones, use of pneumatic injection wells to introduce additional air in the contaminated soil volume, etc.) and report on KM's findings by January 1, 2005.

8. Undertake pilot testing of one or more technologies of enhanced LNAPL recovery and bioremediation in the ground-water zone of the contaminated off-site areas and report on KM's findings by June 1, 2005.

9. Revise the existing groundwater fate and transport model by September 1, 2004 to include the effects of pumping from the City's proposed 2 mgd desalting project to determine the current and future potential range of influent MTBE concentrations. (The model is described in Levine-Fricke, Inc. Final Summary Report, TSO R9-2002-0042. Mission Valley Terminal, 9950 and 9966 San Diego Mission Road, San Diego, CA. January 30, 2004.)

10. Implement a system of enhanced LNAPL recovery and bioremediation in the ground-water zone by September 1, 2005, and demonstrate that observed concentrations of fuel products in off-site ground waters do not exceed MCLs by September 1, 2007. The monitoring wells of compliance with MCLs shall be R-9, R-10, R-11, R-12, R-42 (all wells), R-45 (all wells), R-21 (all wells), and R-30(all wells). Compliance shall be maintained and demonstrated for at least four monthly sampling events following September 2007.

I, John H. Robertus, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of a Time Schedule Order adopted by the California Regional Water Quality Control Board, San Diego region, on __, _________, 2004.

JOHN H. ROBERTUS
Executive Officer

1.0 Introduction

1.1 Water Supply Overview

The City of San Diego Water Department provides water service to approximately 268,000 metered service connections within the City of San Diego. Additionally, the Water Department provides water supply to several adjoining water agencies.

A significant majority of the City's water supply is derived from imported water from the State Water Project or from the Colorado River. Both treated and untreated imported water supplies are delivered to the City by the San Diego County Water Authority (SDCWA) via five pipelines that comprise the San Diego Aqueduct. The Water Department also develops local water supplies through a system of surface water reservoirs and water filtration plants. Depending on local hydrologic conditions, imported water supplies typically comprise from 80 to 90 percent of the City of San Diego water supply.

The City's Long-Range Water Resources Plan, adopted by the City Council in 2002, recognizes that a number of environmental and water rights issues may limit the future availability of imported supplies from the State Water Project and Colorado River. The Long-Range Water Resources Plan envisions a comprehensive strategy to meet San Diego's water needs through the next 30 years. This flexible, multi-faceted strategy includes:

- promoting water conservation to minimize water demand,
- increasing the available imported supply through water transfers,
- providing and promoting the use of recycled water, where feasible, as an irrigation or industrial water supply,
- developing water supplies through sea water desalinization, and
- developing local groundwater aquifers as a source of supply and storage.

Metropolitan Water District of Southern California (MWD) and SDCWA, agencies that provide wholesale imported water to the City of San Diego, also envision increased development of local groundwater resources as a means of assuring adequate future water supplies within the San Diego area. To encourage development of local groundwater supplies, MWD provides financial assistance to its member agencies through the MWD Local Resources Program. The SDCWA Water Resources Plan encourages local groundwater supply development, and anticipates the development of approximately 60,000 acre-feet of groundwater supply by year 2020 within the SDCWA service area.

All or portions of a number of key groundwater basins are within the jurisdiction of the City of San Diego, including:

- San Pasqual Valley,
- Santee/El Monte Basin,
- Lower Tijuana Basin,
- San Diego Formation, and
- Mission Valley.

This study addresses the Mission Valley groundwater aquifer. While the Water Department is interested in exploring both near-term and long-term groundwater development strategies for Mission Valley, this study focuses on near-term strategies (projects that can be implemented by year 2010).

1.2 Purpose of Report

The purpose of this report is to present a concept project for near-term development (by year 2010) of potable water supplies from the Mission Valley groundwater aquifer. To accomplish this objective, this report:

- summarizes potential groundwater development strategies within Mission Valley,
- identifies a conceptual project for developing groundwater supply from the Mission Valley alluvial aquifer,
- identifies facilities required to implement the proposed project,
- presents an opinion of concept-level (order-of-magnitude) probable costs for constructing and operating required facilities,
- identifies tasks required for further development of the project concept,
- identifies required regulatory approvals, and
- presents a schedule for completing the required tasks.

1.3 Study Team

This concept study was prepared by the City of San Diego Water Department under the direction of Ms. Marsi Steirer, Deputy Director, and Mr. Bob McCollough, Water Policy and Planning Division. Michael R. Welch, Ph.D., P.E., Consulting Engineer, served as principal investigator for the study. Questions concerning this report should be directed to:

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Water Policy and Planning Division
City of San Diego Water Department
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San Diego, CA 92101
(619) 533-4222

2.0 *Hydrologic Setting*

2.1 Aquifer Characteristics

The Mission Valley groundwater basin is comprised of Quaternary age alluvium consisting of medium grade to coarse sand and gravel. The Mission Valley alluvial aquifer partially overlies the semi-permeable San Diego and Poway Formations and the impermeable Linda Vista Formation. (DWR, 2003)

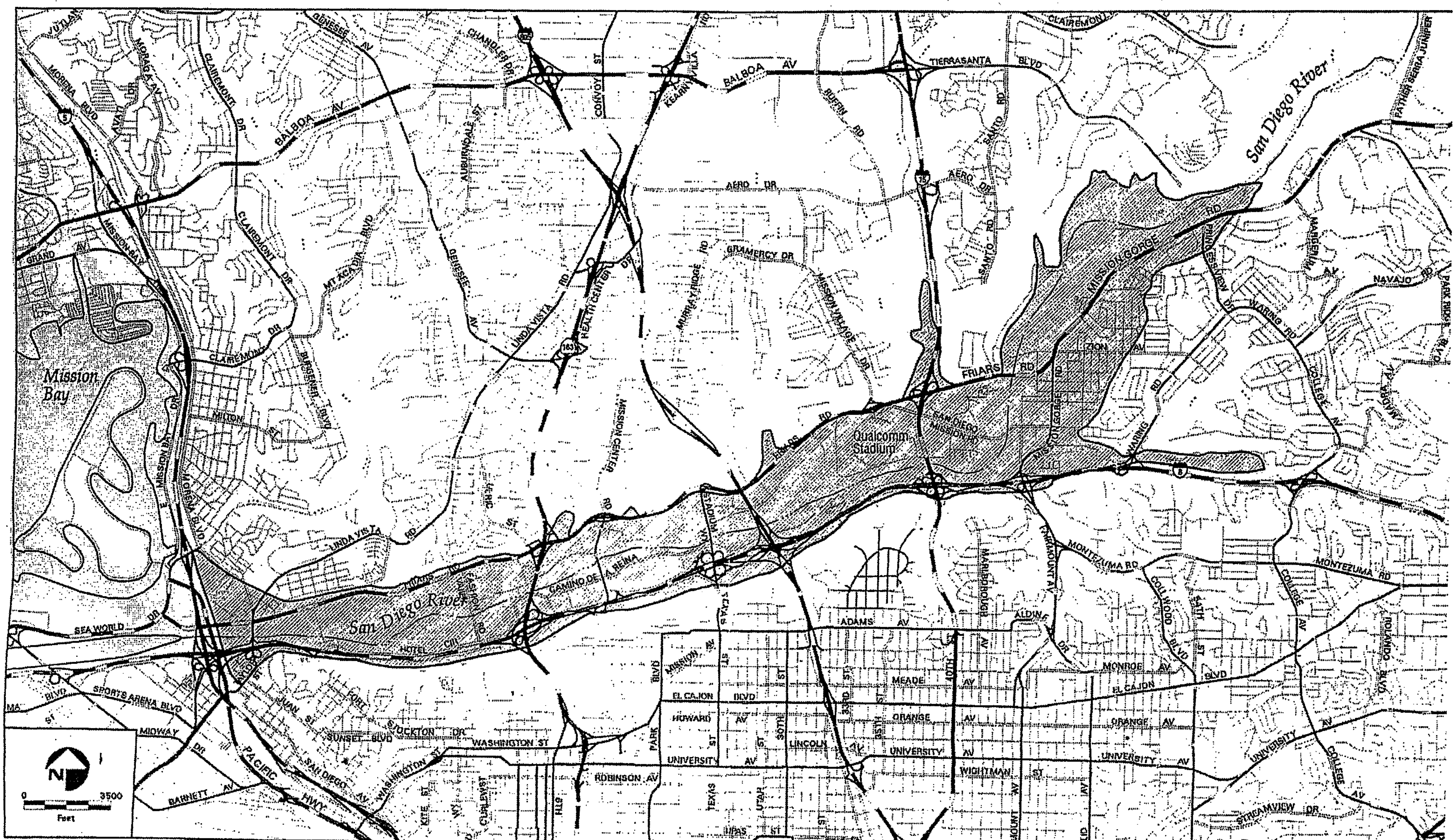
Figure 2-1 (page 2-2) presents the extent of alluvium that comprises the Mission Valley aquifer. As shown in Figure 2-1, the Mission Valley alluvial aquifer is east-west trending along the San Diego River. The narrow alluvial basin is generally less than 4000 feet in width, but extends approximately 8 miles from the lower portion of Mission Gorge to the San Diego River Estuary.

Table 2-1 (page 2-3) summarizes characteristics of the Mission Valley alluvial aquifer. The alluvial fill extends to depths of more than 100 feet in areas, but has an average thickness of approximately 80 feet. (SDCWA, 1997) Well productions within the aquifer of 1000 gpm are typical, but well yields in excess of 1500 gpm have been reported. The average specific yield of the Mission Valley alluvial aquifer is approximately 15 percent. (SDCWA, 1997; DWR, 1965; DWR, 1967)

The primary source of recharge to the Mission Valley alluvial aquifer is streamflow infiltration from the San Diego River. Infiltrating precipitation and applied irrigation water also contributes to groundwater recharge. Because of the porous soils of the alluvial aquifer, recharge from surface flows is rapid, and significant interchange occurs between surface waters and groundwater. Standing or flowing water exists throughout the length of the San Diego River channel within Mission Valley, and the water surface of standing water in ponds and lakes along Mission Valley define the water table elevation. Water table gradients through Mission Valley generally slope westward at a gradient of approximately 0.3 percent

The total groundwater storage capacity of the Mission Valley alluvial basin is estimated at approximately 40,000 acre-feet. (DWR, 1967; SDCWA, 1997) No estimates of hydraulic conductivity have been published for the basin, but a hydraulic conductivity on the order of 100 feet per day can be inferred from available well productivity data and visual drawdown effects of Conrock and H.G. Fenton wells. (CRWQCB, 1978)

INSERT FIGURE 2-1
ADAPTED FROM SDCWA (1997) FIGURE 6-2
MISSION VALLEY ALLUVIAL AQUIFER



SAN DIEGO COUNTY WATER AUTHORITY

MISSION VALLEY GROUNDWATER BASIN: LOWER SAN DIEGO RIVER BASIN

Figure 2-1

Figure Courtesy San Diego County Water Authority

Table 2-1
Summary of Aquifer Characteristics
Mission Valley Alluvial Aquifer

Parameter	Characteristics
Aquifer type	Unconfined alluvium[1,3,4]
Aquifer media	Unconsolidated medium to coarse alluvial sands and gravels[1,3,4]
Primary source of recharge	Streamflow infiltration from San Diego River[1,3,4]
Basin length	8 miles[3,4]
Average basin width	3500 feet[3,4]
Average basin depth	80 feet[1,3,4]
Basin hydraulic conductivity	100 feet per day[3]
Basin storage capacity	40,000 AFY[1,3,4]
Ground surface elevation	10 feet to 120 feet above mean sea level[3]
Approximate groundwater gradient	0.3% westward[3]
Typical well production	> 1000 gallons per minute[1,3,4]
Approximately annual average recharge	5500 acre-feet per year[2]
Existing municipal supply groundwater use	0 AFY[3]
Existing irrigation supply groundwater use	500 AFY[3]

1 From DWR (1965)
2 DMJM and Lowry & Associates (1978) estimated long-term groundwater recharge to the Mission Valley alluvial aquifer at 3500 acre-feet per year (AFY). Current annual recharge to the Mission Valley alluvial aquifer may be significantly larger than this 1978 estimate. As shown in Table 2-3 (page 2-5), post-1975 San Diego River streamflow is approximately 4 cfs higher than historic river flow as a result of reduced upstream groundwater pumping and increased imported water use. Because of the post-1975 increases in San Diego River flow, actual annual recharge to the Mission Valley alluvial aquifer is likely to be in excess of 5500 AFY.
3 From SDCWA (1997). Includes Mission Valley groundwater use upstream (east) of Highway 163.
4 From DWR (2003)

Existing groundwater use within the eastern portion of the Mission Valley alluvial aquifer (east of Highway 163) is limited to golf course irrigation at Admiral Baker Field, and is estimated at approximately 500 AFY. (SDCWA, 1997)

No recent water balance estimates have been published for Mission Valley. A groundwater basin water balance for the Mission Valley alluvial aquifer was published in 1978, however, as part of regional water quality management studies performed per Section 208 of the Clean Water Act. The 1978 Section 208 study estimated long-term groundwater recharge to the Mission Valley alluvial aquifer at approximately 3500 AFY. (DMJM and Lowry & Associates, 1978) This 1978 recharge estimate of 3500 AFY, however, probably underestimates actual long-term available recharge to the Mission Valley alluvial aquifer. As discussed in the following section (see Table 2-3 on page 2-5), post-1975 San Diego River streamflow is approximately 4 cfs higher than historic river flow as a result of reduced upstream groundwater pumping and increased imported water use. Because of the post-1975 increases in San Diego River flow, actual annual recharge to the Mission Valley alluvial aquifer may be in excess of 5500 AFY.

2.2 Surface Water Hydrology

As noted, streamflow infiltration from the San Diego River represents the primary source of recharge to the Mission Valley alluvial aquifer. Streamflows in the San Diego River in Mission Valley are gaged at a U.S. Geological Survey (USGS) gaging station located at Fashion Valley. The USGS Fashion Valley gaging station characterizes San Diego River streamflow in the western portion of Mission Valley.

Streamflow records for the San Diego River at Fashion Valley gaging station are available from 1982 to the present. Table 2-2 summarizes mean daily San Diego River streamflows at the Fashion Valley gaging station from 1982 through 2002. As shown in Table 2-2, the mean daily San Diego River flow during 1982-2002 at Fashion Valley was 41 cubic feet per second (cfs), and the median daily flow was 6.9 cfs.

Table 2-2
Monthly Breakdown of Gaged Streamflow
San Diego River at Fashion Valley

Month	San Diego River at Fashion Valley - Streamflow in cfs[1]			
	Mean Daily Values	Median Daily Values	Maximum Daily Value	Minimum Daily Value
Jan	94	19	3,690	4.3
Feb	114	27	3,280	3.4
Mar	135	28	4,760	4.8
Apr	46	17	838	2.6
May	16.8	6.7	241	1.2
Jun	6.7	3.2	151	0
Jul	3.0	1.6	149	0
Aug	2.4	1.4	76	0
Sep	3.3	1.2	296	0
Oct	6.2	1.5	355	0
Nov	26	6.5	1,130	0
Dec	40	14	759	0.9
Annual Value	41	6.9	4,760	0

1 U.S. Geological Survey stream gaging records for the San Diego River at Fashion Valley for the period January 18, 1982 through September 30, 2002.

No streamflow gaging station exists at the upstream end of Mission Valley, but a USGS gaging station exists at the San Diego River at Mast Boulevard, located approximately 0.7 miles upstream of the Old Mission Dam in Mission Gorge. The Mast Boulevard gaging station characterizes San Diego River streamflow as the river enters Mission Gorge. Since overall streamflow losses to groundwater are minimal within Mission Gorge, the San Diego River at Mast Boulevard gaging station should be reasonably representative of the amount of San Diego River streamflow that enters Mission Valley.

Table 2-3 presents a monthly breakdown of streamflow for the San Diego River at Mast Boulevard for the period 1912-2002. As shown in Table 2-3, storm runoff events (and high

San Diego River streamflows) typically occur during the six-month period December through May. Approximately 90 percent of the total annual streamflow occurs during December through May.

Table 2-3 also presents a comparison of San Diego River streamflow for the periods 1912-2002 and 1975-2002. As shown in Table 2-3, significant differences exist between storm runoff flows and non-storm streamflows for the 1912-2002 and 1975-2002 data periods. Median daily flows in the San Diego River at Mast Boulevard are approximately 4 cfs higher during the period 1975-2002 than during 1912-2002. During June through October, San Diego River post-1975 San Diego River flow is approximately 2 to 3 cfs higher than historic streamflows. The increase in non-storm San Diego River streamflow in the post-1975 era is attributed to:

- decreased groundwater pumping within the central and western portions of the Santee/El Monte Basin (the groundwater basin that is located immediately upstream from Mission Gorge), and
- increased groundwater recharge and urban runoff resulting from increased urbanization and imported water use within the Santee/Lakeside area.

Table 2-3
Monthly Breakdown of Gaged Streamflow
San Diego River at Mast Boulevard

Month	San Diego River at Mast Boulevard – Streamflow in cfs[1]					
	Mean Daily Values		Median Daily Values		Maximum Daily Value	
	1912-2002[2]	1975-2002[3]	1912-2002[2]	1975-2002[3]	1912-2002[2]	1975-2002[3]
Jan	32.1	56.1	4.9	12	2,060	1,950
Feb	92.8	87.3	8.6	16	27,300	3,000
Mar	79.6	109.3	10.0	20	5,350	2,270
Apr	47.8	40.4	6.1	13.0	7,130	778
May	17.7	19.0	2.6	6.6	2,120	278
Jun	4.8	11.8	0.9	3.7	188	188
Jul	3.0	9.0	0.1	2.3	181	181
Aug	2.7	8.0	0.1	2.2	144	144
Sep	1.9	5.3	0.1	2.3	160	160
Oct	2.2	5.6	0.1	2.7	218	218
Nov	5.8	13.8	0.3	4.9	872	798
Dec	20.6	19.5	1.9	7.9	10,600	359
Annual	26.0	32.0	1.7	6.0	27,300	3,000

1 U.S. Geological Survey stream gaging records for the San Diego River near Mast Boulevard in Santee.
2 Streamflow gaging records for the period May 1, 1912 through September 30, 2002. (Within this 1912-2002 data period, data are missing for the period 1/1/1915 through 3/31/1915 and the period 10/1/1923 through 9/30/1925.)
3 Streamflow gaging records for the period January 1, 1975 through September 30, 2002.

As documented in DWR (1967), DWR (1984), Izbicki (1985), and NBS/Lowry (1995), significant changes in groundwater pumping occurred within the Santee/El Monte groundwater basin during the 1970s as (1) imported water became widely available for use, (2) groundwater quality deteriorated, and (3) urbanization limited the amount of agricultural acreage under production in the basin. Decreased groundwater pumping in the Santee/El Monte basin has resulted in increased groundwater table elevations, which have, in turn, resulted in reduced streamflow losses to groundwater infiltration and increased groundwater flows to the San Diego River immediately upstream from Mission Gorge.

As noted on page 2-3, Section 208 water management studies published in 1978 estimated annual recharge to the Mission Valley alluvial aquifer at 3500 AFY. (DMJM and Lowry & Associates, 1978) The increased San Diego River baseflow that has occurred in the past 25 years would indicate that long-term annual potential recharge to the Mission Valley alluvial aquifer could be significantly higher than this 1978 estimate. As shown in Table 2-3, post-1975 San Diego River streamflows are higher than historic flows by approximately 4 cfs, which translates to approximately 2900 AFY of additional streamflow entering Mission Valley. Since the increased streamflow occurs on a year-round basis, a significant portion of this additional streamflow could infiltrate into the Mission Valley alluvial aquifer provided that adequate groundwater storage capacity were available. Actual long-term groundwater recharge to the Mission Valley alluvial aquifer is thus likely on the order of 5500 AFY.

2.3 Groundwater Quality

A significant amount of historical groundwater quality data exists for the Mission Valley alluvial aquifer. Because of a reduction in groundwater use within the past two decades, however, no recent comprehensive water quality studies have been performed to assess the Mission Valley alluvial aquifer. Historic groundwater data and recent surface water quality data, however, can be used to estimate the current probable quality of groundwater within the Mission Valley alluvial aquifer.

The Mission Valley alluvial aquifer is within the Mission San Diego Hydrologic Subarea. Table 2-4 (page 2-7) presents groundwater quality objectives established by CRWQCB for the Mission San Diego Hydrologic Subarea. Table 2-4 also summarizes the range of reported groundwater concentrations for the Basin Plan constituents. Several water quality parameters are of concern in assessing the usability of Mission Valley alluvial groundwater as a source of municipal supply:

- dissolved minerals,
- nitrate,
- iron and manganese,
- toxic inorganic compounds, and
- toxic organic compounds.

The following sections discuss these categories of contaminants.

Dissolved Minerals. No state or federal primary Maximum Contaminant Levels (MCLs) have been established for total dissolved solids (TDS) or dissolved minerals such as chloride, sulfate, sodium, calcium, manganese, and potassium. As shown in Table 2-4, California

Department of Health Services (DHS) establishes a secondary (non-enforceable) MCL for TDS in municipal supplies at 500 mg/l. A recommended State of California secondary (non-enforceable) MCL of 250 mg/l is established by DHS for both chloride and sulfate. The secondary MCLs for TDS, chloride, and sulfate are established primarily to insure acceptable water taste.

Table 2-4
Summary of Basin Plan Water Quality Objectives and Historic Groundwater Quality
Mission Valley Alluvial Aquifer

Constituent	Concentration in mg/l			
	Basin Plan Groundwater Quality Objective[1]	Primary State of California MCL[2]	Secondary State of California MCL[3]	Approximate Reported Range in Historic Groundwater Quality
Total dissolved solids, TDS	3000	None	500	700 – 3100[4,5]
Chloride	800	None	250	200 – 1000[4,5]
Sulfate	600	None	250	100 – 800[4,5]
Fluoride	1.0	2.0	4.0	< 1.0[5]
Boron	2.0	None	None	0.2 - 0.5[4,5]
Nitrate (as N)	10	10	None	< 10[5]
Iron	0.3	None	0.3	< 0.3[5]
Manganese	0.05	None	0.05	< 0.05[5]

1 From CRWQCB (1994).
2 Primary drinking water standards per DHS (2003a).
3 Secondary drinking water standards per DHS (2003b).
4 From CRWQCB (1985) and NBS/Lowry (1989).
5 From DWR (1967).

Groundwater total dissolved solids (TDS) concentrations within the Mission Valley alluvial aquifer are highly variable, and are dependent on location and hydrologic conditions. SDCWA (1997) and CRWQCB (1984) report that groundwater TDS concentrations within the Mission Valley alluvial aquifer can range from less 1000 mg/l to more than 3000 mg/l. In general, groundwater TDS concentrations tend to increase with distance downstream in Mission Valley. Because of the significant interchange between ground and surface water within Mission Valley, however, groundwater TDS concentrations can improve significantly during years of above-normal flow in the San Diego River. Mission Valley alluvial aquifer TDS concentrations tend to increase over time during drought periods, as the aquifer recharge is largely comprised of infiltrating urban runoff. (CRWQCB, 1984; NBS/Lowry, 1989.)

No recent published data are available to characterize the nature of dissolved solids, but historic data from CRWQCB (1984) indicates that Mission Valley alluvial aquifer groundwater is dominated by anions chloride and sulfate, and the cations sodium and calcium. Chloride concentrations were reported to range from approximately 200 mg/l to nearly 1000 mg/l, while sulfate concentrations ranging from 100 mg/l to over 750 mg/l were reported.

Sodium concentrations were reported to range from approximately 200 mg/l to over 600 mg/l, while calcium concentrations ranged from approximately 60 mg/l to 400 mg/l.

Nitrate. Nitrate is an important parameter in assessing groundwater use for municipal purposes for two reasons. First, the state and federal government has established a primary (enforceable) nitrate MCL of 10 mg/l (as nitrogen). Second, nitrate is a relative small ion, and it is not easily removed from water, even by some types of reverse osmosis membranes.

Previously published studies on the Mission Valley alluvial aquifer do not list recent data for nitrate. Historic groundwater data, however, indicates that groundwater nitrate concentrations within the Mission Valley alluvial groundwater aquifer are consistently less than the 10 mg/l (as N) state and federal nitrate MCL. (DWR, 1967)

Iron and Manganese. Iron and manganese are important constituents for assessing groundwater as a source of municipal supply, as iron and manganese can result in fouling of reverse osmosis membranes. Additionally, while no state or federal primary drinking water standards exist for iron and manganese, state and federal secondary (non-enforceable) MCLs for iron and manganese are respectively 0.3 and 0.05 mg/l.

While no recent published iron and manganese data are available, historic data presented by DWR (1967) indicates that Mission Valley groundwaters were generally in compliance with the secondary drinking water standards for iron and manganese.

Inorganic Contaminants. State and federal primary drinking water standards exist for a variety of inorganic contaminants, including: aluminum, antimony, arsenic, asbestos, barium, beryllium, chromium, copper, cyanide, lead, mercury, nickel, selenium, and thallium.

Previously published DWR studies on the Mission Valley alluvial aquifer do not list data for inorganic constituents. Storm runoff and dry season surface water quality monitoring within the San Diego River, however, has been performed by the San Diego County Municipal Stormwater Copermittees. Surface water quality data collected by the copermittees show that San Diego River streamflow is in compliance with applicable drinking water standards for inorganic constituents. (MEC, 2003) Since infiltrating surface flow is the primary source of recharge to the Mission Valley alluvial aquifer, it can be inferred that concentrations of metals in Mission Valley groundwater should be within applicable drinking water MCLs (except in aquifer zones influenced by surface leaks of organic contaminants).

Organic Contaminants. State and federal MCLs exist for a variety of toxic organic constituents. Little information exists on concentrations of organic contaminants in many portions of Mission Valley. Groundwaters in the vicinity of Qualcomm Stadium, however, are contaminated with hydrocarbons and methyl tertiary butyl ether (MTBE) that originated from fuel storage facilities at the Mission Valley Terminal, located near the intersection of Interstate 15 and Friars Road.

Dissolved hydrocarbons were first detected beneath the Qualcomm Stadium Parking lot in 1992, and CRWQCB ordered Kinder Morgan Energy Partners, operator of the Mission Valley

Terminal, to monitor the extent of the discharge and remediate the discharge. In response to the CRWQCB directive, a pump and treat remediation system was implemented in 1994 that pumps and treats approximately 170,000 gallons per day (gpd) of contaminated groundwater. Treated groundwater is discharged to Murphy Canyon, a tributary to the San Diego River in accordance with CRWQCB general NPDES permit No. 2001-96.

Groundwater samples show dissolved hydrocarbons in a plume extending more than 1000 feet downgradient (southwest) of the Mission Valley Terminal. MTBE has been detected in groundwaters more than one mile downstream from the terminal. MTBE concentrations exceeding 150 micrograms per liter (µg/l) have been reported in groundwaters in the immediate vicinity of the Mission Valley Terminal. MTBE has been detected in concentrations exceeding 50 ug/l in groundwaters immediately west of Qualcomm Stadium. (CRWQCB, 2003) For reference, the DHS primary drinking water standard for MTBE is 13 ug/l.

3.0 *Groundwater Development Strategies*

3.1 Potential Strategies

While groundwater aquifers can serve as a source of water supply, groundwater aquifers can also provide a number of additional benefits, including:

- seasonal, carry-over, or long-term water storage,
- water conveyance throughout the extent of the aquifer, and
- water treatment, through the natural filtration of aquifer soils.

Depending on aquifer characteristics, water agency needs, economics, institutional considerations, and other factors, a variety of groundwater development strategies can be crafted to take advantage of any or all of the above water supply benefits. Two general classifications of groundwater resources development strategies exist:

- strategies that rely on naturally-occurring groundwater recharge, and
- strategies that involve supplemental groundwater recharge.

Strategies that rely on naturally-occurring groundwater recharge are appropriate when (1) proposed groundwater pumping rates are less than the long-term natural recharge, and (2) proposed pumping rates do not adversely impact the environment or other beneficial uses of local ground and surface waters. If supplemental recharge is not required, groundwater development projects can be classified on the basis of frequency of groundwater withdrawal and treatment needs. Table 3-1 (page 3-2) summarizes potential groundwater withdrawal and treatment options.

Table 3-2 (page 3-2) summarizes potential groundwater recharge sources and groundwater recharge methods available. Strategies that rely on supplemental groundwater recharge are appropriate when:

- proposed groundwater pumping rates are higher than the naturally-occurring recharge,
- the project goal includes development of seasonal, carry-over, or long-term storage, or
- supplemental recharge is necessary to mitigate against pumping impacts to other water users or beneficial uses.

Table 3-1
Potential Groundwater Withdrawal and Treatment Strategies

Project Element	Available Groundwater Development Options	Description of Option
Frequency of Withdrawal	Continuous withdrawal	Appropriate if groundwater treatment is required in order to maximize economic returns and make year-round use of treatment facilities.
	Seasonal withdrawal	Appropriate if objective of groundwater project is to provide seasonal storage or to meet peak water demands.
	Intermittent withdrawal	Appropriate if objective of groundwater project is to provide carry-over storage.
	Emergency withdrawal	Appropriate if objective of groundwater project is to provide long-term or emergency source of water supply.
Treatment of Withdrawn Groundwater	Iron and manganese removal	Required where groundwater iron and manganese concentrations exceed drinking water standards or exceed allowable influent treatment process inhibition limits.
	Demineralization	Used for removing dissolved minerals, organic compounds, and inorganic compounds.
	Carbon filtration	Used for removing organic compounds if groundwater salinity does not require demineralization.
	Coagulation/Filtration	Required where withdrawal wells are determined by DHS to be under the influence of surface waters.
	Disinfection	May be required to insure compliance with DHS bacteriological standards.

Table 3-2
Potential Strategies for Providing Supplemental Aquifer Recharge

Project Element	Potential Options	Description of Option
Source of Supplemental Recharge Water	Imported water	Appropriate if access to unfiltered imported supply is available.
	Surface water releases	Appropriate where upstream surface storage reservoirs exist and reservoir releases do not result in subsequent environmental impacts.
	Enhanced surface recharge	Appropriate where river channel or tributary improvements can result in increased streamflow infiltration without causing impacts to beneficial uses.
	Recycled water	Appropriate if recycled water supply is available and recycled water recharge is consistent with proposed use of groundwater.
Method of Supplemental Recharge	Streamflow Infiltration	Appropriate for alluvial aquifers with permeable stream channels, where recharge flows can be implemented without causing impacts to beneficial uses.
	Percolation ponds	Appropriate for alluvial aquifers with permeable soils where large recharge sites are available.
	Injection wells	Appropriate for use with confined or unconfined aquifers where land is at a premium..

To increase basin yields above the natural perennial yield, the natural recharge may be augmented by supplemental recharge from such sources as: unfiltered imported water, surface water releases from upstream reservoirs, captured surface runoff, or recycled water. Supplemental recharge may be introduced into an unconfined aquifer by releases to streamflows, groundwater recharge via percolation ponds, or groundwater recharge via injection wells. Supplemental recharge may be introduced to confined aquifers using injection wells.

3.2 Constraints to Near-Term Groundwater Recharge/Withdrawal

The City of San Diego Water Department is interested in exploring both near-term and long-term groundwater development strategies for Mission Valley. Near-term strategies include projects that could be implemented by year 2010.

Several key issues affect which near-term and long-term groundwater recharge/withdrawal strategies may be appropriate for groundwater development within Mission Valley. Key among these issues is the need to insure protection of:

- habitat that exists along the length of the San Diego River in Mission Valley that is dependent on groundwater or surface flows from the San Diego River,
- aquatic habitat in the San Diego River,
- river hydraulics, and
- the aesthetic appearance of San Diego River

Chapter 2 presents a summary of the hydrogeology of the Mission Valley groundwater system. Important findings presented in Chapter 2 that are applicable to assessing Mission Valley groundwater development strategies are summarized below, along with conclusions regarding near-term and long-term groundwater development in Mission Valley:

- Current pumping of the Mission Valley alluvial aquifer is less than historic pumping rates. Current annual and dry season San Diego River flows are several cfs higher than historic values, indicating that current aquifer recharge is higher than was historically available.
- Water surface levels along the river exist at the groundwater table and streamflow infiltration is high. Surface flow in the river can be maintained as long as pumping rates are less than available recharge rates. Provided that surface flow in the river is maintained, pumping wells can be operated so as to not discernibly impact groundwater table elevations or water surface levels in the immediate vicinity of the San Diego river channel.
- The Mission Valley aquifer is highly porous and has a high hydraulic conductivity, indicating that well drawdowns per unit of withdrawn flow are low.
- While Mission Valley alluvial aquifer well production rates are high, use of multiple wells may be useful to minimize impacts to groundwater table elevations.

- Available annual and dry-season recharge to the Mission Valley alluvial aquifer appears adequate to sustain groundwater pumping on the order of 2 mgd (2200 AFY) or more without discernibly impacting groundwater table elevations in sensitive habitat areas or affecting surface water levels in the river channel.
- Pumping rates in excess of available recharge rates does not appear to represents a near-term water development option. Such high pumping rates may cause significant loss of surface flow in the San Diego River and cause local and regional drawdown in the water table. Additional sources or ground and/or surface water recharge would be required to sustain such pumping rates and mitigate against impacts to habitat and river aesthetics. Significant additional study would be required to assess such effects. Because of the need for comprehensive study, such pumping rates should be considered as part of long-term groundwater development plans.
- Raw (unfiltered) water does not appear to represent a near-term source of available recharge for the Mission Valley alluvial aquifer. Available sources of raw (unfiltered) water for recharge in Mission Valley include (1) the Second San Diego Aqueduct near Lake Murray and (2) the First San Diego Aqueduct near San Vicente, and (3) surface releases from San Vicente or El Capitan Reservoirs. Conveyance of such raw water to Mission Valley would either entail lengthy pipelines through difficult terrain/development, or discharge to surface streams. Significant environmental analysis would be required to assess the environmental feasibility of raw water transport via surface streams.
- Recycled water does not represent a viable near-term source of supplemental recharge to the Mission Valley alluvial aquifer. No recycled water pipelines are currently located in the vicinity of Mission Valley. Additionally, use of recycled water as a source of recharge to a potable water groundwater would have to be implemented in accordance with DHS Groundwater Recharge Guidelines. The narrow nature of Mission Valley would make it difficult to demonstrate compliance with Groundwater Recharge Guidelines for horizontal setback, minimum underground travel time, and percent contribution limits.
- Use of the Mission Valley alluvial aquifer for seasonal or carry-over storage does not appear to represent a viable near-term water development strategy. Sources or supplemental aquifer recharge are not available in the near-term. Additionally, such seasonal storage use could involve significant fluctuation in seasonal groundwater table elevations. Significant environmental study would be required to assess the feasibility of such seasonal water table fluctuations, to assess impacts to habitat and river hydraulics, and to determine if it is feasible to mitigate impacts.

On the basis of the above conclusions, near-term water supply development from the Mission Valley alluvial aquifer will need to be limited to a modest size (on the order of 2 mgd or 2200 AFY of groundwater pumping) in order to:

1) insure non-discernible impacts to habitat and the San Diego River, and
2) simplify evaluation of project impacts and reduce the length and complexity of required assessment studies.

Continuous year-round operation (as opposed to seasonal or peaking operations) is required to maximize use and economic return of constructed facilities.

Such a modestly sized near-term project would allow water supply development without resulting in discernible changes in groundwater table elevations along the San Diego River. In this way, protection of aquatic and riparian habitat is assured, along with prevention of discernible impacts to river hydraulics or river aesthetics. Additionally, such a near-term water supply project would allow development of additional water quality and aquifer characteristics data that would prove useful in assessing long-term groundwater supply development strategies within the Mission Valley alluvial aquifer.

3.3 Treatment of Mission Valley Groundwater

The type of groundwater treatment required in order to produce potable supply water from the Mission Valley alluvial aquifer groundwater will be dependent on the quality of the withdrawn groundwater. As summarized in Chapter 2, a significant amount of historic groundwater quality data are available for Mission Valley, but only limited data are available for recent years.

Additional data will be required to refine groundwater treatment needs, but the existing historic data offers a useful guide to the degree of required treatment. Table 3-3 (page 3-6) summarizes groundwater treatment options and applicability to Mission Valley groundwater. As shown in Table 3-3, demineralization will be required for a portion of the Mission Valley groundwater flow in order to meet DHS secondary drinking water standards for TDS (500 mg/l), chloride (250 mg/l), and sulfate (250 mg/l).

Demineralization or carbon treatment of all or a portion of the groundwater flow may be required if the Mission Valley Terminal MTBE and hydrocarbon spill is not cleaned up by the time the Mission Valley groundwater project comes online. Proposed cleanup of the spill by 2010, however, would be consistent with the City's goal of near-term development of Mission Valley groundwater supplies, provided that sufficient cleanup progress is achieved by 2005 to satisfy DHS source water concerns and allow the City Council to approve and fund required project development tasks.

Historic Mission Valley groundwater quality data do not indicate that iron and manganese treatment will be required to either meet DHS secondary drinking water standards or to prevent inhibition effects in the demineralization process. Up-to-date water quality data will be required, however, to assess current iron and manganese concentrations and confirm that iron and manganese treatment is not required for Mission Valley groundwater.

Disinfection will be required of 100 percent of the withdrawn groundwater in order to insure adequate public safety.

Table 3-3
Applicability of Treatment Options to Mission Valley Alluvial Aquifer

Type of Treatment	Required for a Portion of Withdrawn Groundwater	Required for 100 Percent of Withdrawn Groundwater
Coagulation/Filtration	Possible[1]	Not applicable
Iron & Manganese Removal	Possible[2]	Possible[3]
Demineralization and demineralization pretreatment	Yes[4]	Possible[5]
Carbon filtration	Possible[6]	Possible[6]
Disinfection	Not applicable	Yes

1 Coagulation/filtration treatment may be required for withdrawn groundwater if DHS determines that Mission Valley alluvial aquifer groundwater wells are under the influence of surface waters. As noted in Footnote 3, demineralization treatment will be required for a portion of the withdrawn groundwater, and such demineralization treatment will satisfy DHS surface water treatment requirements. Thus, if Mission Valley wells are determined to be under the influence of surface waters, coagulation/filtration may be required for the portion of the withdrawn groundwater that does not receive demineralization treatment.

2 Historic water quality data do not indicate that iron and manganese exist in the groundwater in sufficient concentrations to inhibit demineralization processes. Addition water quality data will be required to confirm that iron and manganese inhibition effects will not occur. If future water quality data indicate the potential for inhibition effects, iron and manganese removal would be required as pretreatment to the demineralization process.

3 Historic water quality data do not indicate that iron and manganese treatment will be required in order to comply with DHS secondary drinking water standards. Additional water quality data will be required to confirm iron and manganese compliance. If future water quality data show potential noncompliance of Mission Valley groundwater with DHS iron and manganese standards, iron and manganese treatment could be required for 100 percent of the withdrawn groundwater.

4 Demineralization treatment will be required for a portion of the pumped Mission Valley groundwater flow in order to comply with DHS secondary standards for TDS and dissolved minerals.

5 Demineralization of 100% of the withdrawn groundwater may be required if cleanup of the Mission Valley Terminal MTBE and hydrocarbon spill is not achieved by the time the groundwater recovery project comes online.

6 Carbon filtration of a portion or 100% of the withdrawn groundwater may be required if cleanup of the Mission Valley Terminal MTBE and hydrocarbon spill is not achieved by the time the groundwater recovery project comes online.

3.4 Proposed Near-Term Groundwater Development Concept

As concluded in Section 3.3, significant additional analyses will be required to resolve environmental, engineering, and geotechnical uncertainties associated with supplemental groundwater recharge or large-scale groundwater withdrawal from the Mission Valley alluvial aquifer. Once appropriate long-term studies are completed, supplemental recharge or large-scale groundwater withdrawals may prove to be feasible long-range programs. To achieve the year 2010 implementation target, however, near-term water development strategies will have to be based on modest groundwater withdrawals that are less (and less by a significant margin) than the natural recharge capacity of the Mission Valley aquifer.

Proposed Project Concept. To insure non-discernible impacts to habitats and groundwater table elevations near the river, it is recommended that near-term groundwater supply development within the Mission Valley alluvial aquifer be limited to groundwater withdrawals of roughly 2 mgd (2200 AFY). Because of the brackish nature of Mission Valley alluvial groundwaters, demineralization treatment will be required. To maximize economic return and use of facilities, continuous year-round groundwater withdrawal and treatment would be required.

In accordance with these conclusions, the following is recommended as an appropriate near-term water supply development project concept:

- year-round withdrawal of approximately 2 mgd (2200 AFY) of alluvial aquifer groundwater,
- demineralization of portion of the withdrawn flow to achieve a target TDS concentration of 500 mg/l in the final treated potable supply,
- disposal of waste brine in the Metropolitan Sewer System (Metro System),
- disinfection of treated potable supplies, and
- conveyance of the produced potable supply to the City of San Diego water distribution system.

Proven Nature of Concept. Demineralization of brackish groundwater represents a proven means of developing local potable water supply. Two existing brackish groundwater desalting projects are currently operational within San Diego County.

City of Oceanside. Many parallels exist between City of San Diego groundwater development opportunities in Mission Valley and City of Oceanside groundwater development within the Mission (Lower San Luis Rey) Groundwater Basin. After several years of initial planning, design, and environmental review, initial City of Oceanside groundwater desalting operations began in 1993 with the implementation of a 2 mgd reverse osmosis desalting facility that treated brackish groundwater from three City of Oceanside groundwater wells. TDS concentrations in the brackish groundwater were approximately 1800 mg/l. In addition to developing potable water supply, operation of the initial 2 mgd desalting facility was used to develop additional aquifer water quality and performance data for use in assessing expanded groundwater development opportunities. Operation of the facility proved sufficiently successful that the City implemented an additional well field and, in 2003, expanded groundwater desalting facilities to a capacity of 6.37 mgd.

Sweetwater Authority. In 1999, Sweetwater Authority (SWA) initiated operation of the 4.0 mgd Richard A. Reynolds Groundwater Desalination Facility. The SWA Reynolds desalination facility treats brackish groundwater pumped from the Lower Sweetwater River alluvial basin and the deeper San Diego Formation.

Comparison of Brackish Groundwater and Sea Water Desalination. While both brackish groundwater desalination and sea water desalination are part of the City's Long Range Water Resources Plan, the City recognizes that demineralization of brackish groundwater offers a number of advantages over sea water desalinization, including:

- desalting brackish groundwater is significantly less expensive, less energy intensive, and less complicated than desalting sea water, as TDS concentrations in sea water are approximately 20 times higher than concentrations in brackish groundwaters such as Mission Valley, and

- groundwater aquifer soil media filter out particulate matter and biological matter that may foul demineralization processes, while significant pretreatment is required to achieve the same filtration effects in sea water desalination projects.

Mission Valley Assets Compatible with Project Concept. Several key existing City of San Diego assets will be highly beneficial (and critical) for near-term development of Mission Valley groundwater supplies. These assets include:

Availability of City-Owned Land. The City owns several parcels of land in Mission Valley, the largest of which is the Qualcomm Stadium site. Historic wells that existed on the site prior to development of the stadium indicate excellent well production and groundwater recharge characteristics, and it would be possible to situate a compact groundwater demineralization facility on the edge of the Qualcomm Stadium site. Wells with subsurface well-head facilities could be located within the stadium parking lot. In addition to excellent aquifer characteristics, the Qualcomm Stadium site is located sufficiently upstream to avoid potential sea water intrusion issues. The site is also located sufficiently downstream from the Admiral Baker Golf Course to avoid cumulative draw-down effects. As a final advantage, adequate electrical power service is available at the Qualcomm Stadium site. MTBE and hydrocarbon contamination resulting from spills from the Mission Valley Terminal represents a water supply development obstacle. To avoid impacting the City's proposed beneficial use of Mission Valley groundwater, efforts to clean up the spills must be consistent with the City of San Diego near-term water supply development goals for the Mission Valley alluvial aquifer. At a minimum, sufficient cleanup must be achieved by 2005 to satisfy DHS source water concerns and to provide sufficient assurance to the City Council to consider funding required for project development tasks.

Availability of Brine Disposal. The object of demineralization facilities is to separate dissolved salts from water; waste brine is a byproduct. Lack of brine disposal means is often a key factor in affecting the feasibility of brackish groundwater demineralization. It is not feasible to discharge waste brine to Mission Valley storm drains or surface waters, as anticipated brine concentrations are significantly higher than applicable CRWQCB Basin Plan ground and surface water quality objectives. Large-scale sewer disposal facilities in the area of Qualcomm Stadium, however, are available for brine disposal. The North Mission Valley Interceptor runs through the south portion of the Qualcomm Stadium site parallel to the San Diego River. The interceptor ranges in diameter from 96 inches (southeastern portion of Qualcomm Stadium site) to 84 inches in diameter (southwestern portion of Qualcomm Stadium site). The North Mission Valley Interceptor has adequate capacity to handle waste brine flows from a Mission Valley brackish groundwater desalting facility. Additionally, no recycled water facilities (which would be adversely affected by brine loads) exist downstream from Mission Valley, rendering brine discharge to the sewer physically feasible.

Availability of Large-Scale Potable Water Conveyance Facilities. Existing large-scale water conveyance pipelines in the vicinity of Qualcomm Stadium represents a final asset useful for near-term implementation of brackish groundwater desalination in Mission Valley. The 48-inch-diameter Alvarado Pipeline No. 2 traverses the north portion of the Qualcomm site parallel to Friars Road. The size and location of Alvarado Pipeline No. 2 will allow developed potable supplies to be diverted directly into the City's potable water system without the need for additional offsite conveyance facilities.

Additional Project Benefits. In addition to developing potable water supplies and reducing the demand for imported water, implementation of a near-term groundwater demineralization project in Mission Valley will provide additional benefits, including:

Emergency Water Supply. A Mission Valley groundwater desalting program would represent a source of local supply that could be available to supplement other local supplies and local water storage in the event of interruption of imported supplies.

Reduced Regional Electrical Power Consumption. Groundwater pumping and demineralization treatment requires less electrical power than conveying Colorado River water (the prime source of San Diego's imported water supply) to San Diego.

Development of Aquifer Data. Near-term (year 2010) implementation of a Mission Valley groundwater desalting program would allow the City to develop water quality, well performance, and aquifer characteristics data. Such data will be useful in developing and evaluating potential long-term groundwater development opportunities within Mission Valley.

Water Quality Improvement. As documented by SDCWA (1997), water quality degradation in San Diego County coastal valley groundwater basins has, in part, resulted from increased basin mineral loads and decreased groundwater pumping. With little existing pumping, groundwater in underutilized basins is subjected to natural and man-induced mineral loads over long periods of time. These mineral loads in combination with long groundwater detention times result in continued degradation of water quality. Groundwater pumping in combination with groundwater desalination represents a viable strategy for achieving long-term improvement in alluvial aquifer groundwater quality. Two factors influence such water quality improvement. First, withdrawal of poor-quality groundwater provides basin capacity for the infiltration of better-quality storm runoff. Second, groundwater pumping and subsequent streamflow infiltration recharge reduce the overall hydraulic detention time within the groundwater basin. Reducing the hydraulic detention time results in natural and man-induced mineral loads being spread over a greater quantity of groundwater, and having less "exposure time" to degrade groundwater quality. The resulting effect is a long-term improvement to groundwater quality.

4.0 *Proposed Project*

4.1 Overview of Project Concept

This chapter presents a proposed project for near-term (year 2010) development of potable water supply from the Mission Valley alluvial aquifer. The Mission Valley Groundwater Desalter Project (MVGDP) proposed herein is based on the concept presented in Section 3.4, and involves:

- year-round withdrawal of approximately 2 mgd (2200 AFY) of alluvial aquifer groundwater,
- demineralization of portion of the withdrawn flow to achieve a target TDS concentration of 500 mg/l in the final treated potable supply,
- disinfection of treated potable supplies, and
- conveyance of the produced potable supply to the City of San Diego water distribution system.

Table 4-1 (page 4-2) conceptually summarizes the proposed MVGDP. Key MVGDP facilities will include extraction wells, groundwater conveyance lines, a groundwater demineralization facility, brine disposal facilities, and potable water conveyance facilities.

Reverse osmosis membrane filtration is recommended as demineralization treatment. Reverse osmosis membrane filtration is a proven and reliable demineralization technology. As noted in Section 3.4, reverse osmosis technology is already in use within San Diego County by the City of Oceanside and Sweetwater Authority for groundwater desalting programs identical in concept to MVGDP.

Figure 4-1 (page 4-2) presents a schematic of the proposed MVGDP. As shown in Figure 4-1, it is projected that MVGDP will produce approximately 1.76 mgd (1,970 AFY) of treated potable supply and approximately 0.24 mgd of waste brine.

Detailed siting studies will be required for locating groundwater wells and the treatment facility. As discussed in Section 3.4, however, the Qualcomm Stadium site presents a number of advantages for siting groundwater wells and the demineralization facility, including:

- the site is already owned by the City,
- right-of-way issues are avoided,
- minimum construction impacts occur due to the pre-developed nature of the site,
- power is available at the Qualcomm Stadium site,

**Table 4-1
Project Concept
Mission Valley Groundwater Desalter Project**

Project Element	Description
Source Aquifer	Mission Valley alluvial aquifer
Annual Groundwater Pumping	2 mgd[1] (2200 AFY)
Frequency of Groundwater Withdrawal	Continuous, year-round groundwater pumping
Supplemental Aquifer Recharge	None[2]
Potable Water Production	1.76 mgd[3]
Water Production TDS Goal	500 mg/l
Key Facilities:	• Extraction wells and conveyance lines • Groundwater demineralization facility • Brine connection to North Mission Valley Interceptor • Booster pump station and conveyance main to City of San Diego water system (Alvarado Pipeline No. 2)

1 A 2 mgd (2200 AFY) pumping rate is selected for the project concept on the basis of (1) sufficient available natural recharge is available, (2) pumping rate appears consistent with avoiding depth-to-water impacts to groundwater dependent vegetation, and (3) the pumping rate appears consistent with avoiding impacts to San Diego River surface waters. Additional environmental studies will be required to confirm the suitability of the proposed 2 mgd pumping rate.

2 No supplemental groundwater recharge is required. Natural recharge to Mission Valley alluvial aquifer is sufficient for proposed 2 mgd groundwater pumping rate.

3 Potable water production rate will, in part, depend on the TDS concentration of withdrawn groundwater, the percent of withdrawn groundwater that requires demineralization treatment, and reverse osmosis membrane performance. See Table 4-3 on page 4-7 for details.

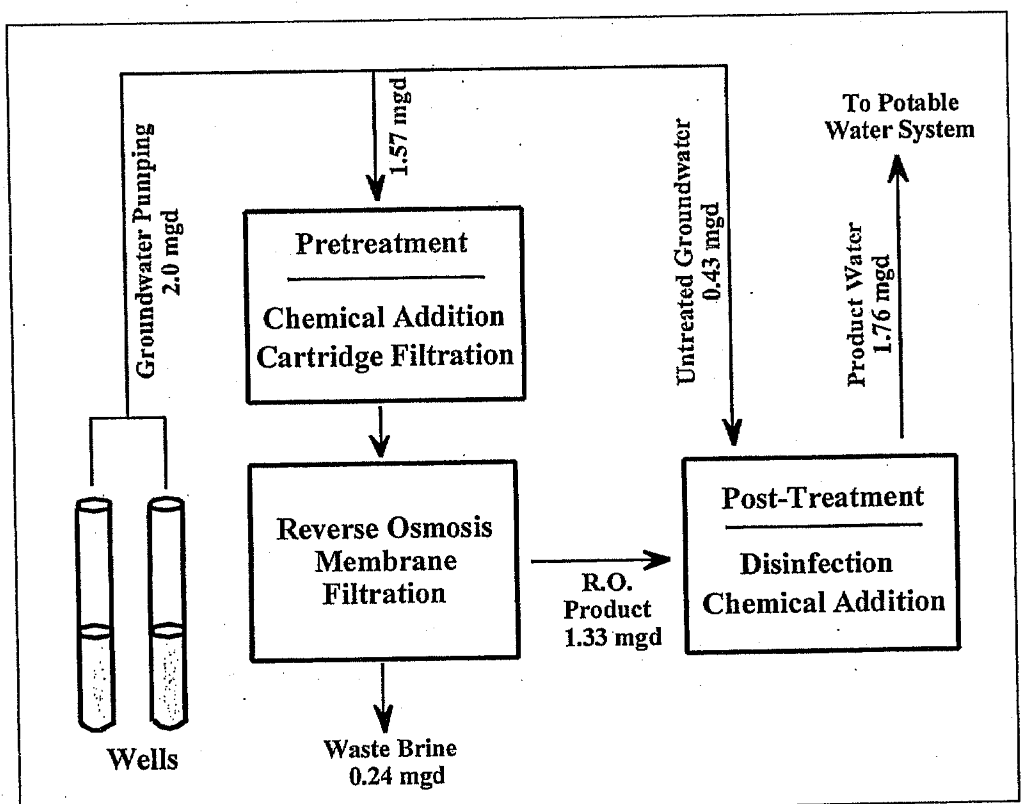


Figure 4-1 Schematic of Proposed Mission Valley Groundwater Desalter Project (Based on 1500 mg/l TDS concentration in groundwater supply)

- required water facilities can be constructed and operated without impacting existing Qualcomm Stadium site uses,
- proximity to North Mission Valley Interceptor for brine disposal,
- proximity to large-scale potable water distribution facilities for distribution of the developed potable supply, and
- favorable aquifer characteristics.

Figure 4-2 (page 4-4) presents an aerial photograph of Mission Valley, with an overlay that shows a possible location for MVGDP treatment facilities and the well field. As shown in Figure 4-2, the compact treatment plant site could be located in a corner of the Qualcomm Stadium site so as to provide truck access without affecting existing site uses. Groundwater wells could be constructed in the stadium parking lot.

4.2 Groundwater Production Facilities

Groundwater Wells. As discussed in Chapter 2, Mission Valley alluvial aquifer characteristics allow for high yield groundwater wells in the vicinity of Qualcomm Stadium. Wells with yields exceeding 1000 gpm have existed on or adjacent to the Qualcomm Stadium site in past years.

While subsequent geotechnical studies may demonstrate that a single 1400 gpm (2.0 mgd) well could theoretically provide 100% of the MVGDP water supply needs, it is recommended that MVGDP include a minimum of three supply wells. Advantages provided by three wells include:

- the 2.0 mgd MVGDP inflow can be provided with one well out of service,
- increased system operational flexibility,
- the blend of supply from the wells can be modified in response to short-term or long-term changes in water quality in any of the wells, and
- multiple wells spread over a larger area reduce impacts to groundwater table elevations.

Site geotechnical studies will be required to develop well design specifications and well sites. As part of the siting process, it will be necessary to solicit DHS input regarding flood protection and surface water treatment compliance issues. Table 4-2 (page 4-5) summarizes probable well characteristics. As shown in Table 4-2, well depths extending approximately 120 feet (through the bottom of the Mission Valley alluvium) with a 16-inch cased diameter should prove sufficient for a target yield of 750 gpm or more. The wells would feature a 50 foot sanitary seal, and would be screened below the 50 foot depth. If sufficient runoff control is provided, it is possible that DHS may allow construction of the wells with below-grade well-head facilities so as to minimize impacts to activities within the stadium parking lot.

In addition to production wells, small-diameter monitoring piezometers will be required to assess effects of groundwater pumping on groundwater table elevations. For planning purposes, it is anticipated that four 75-foot-deep piezometers will be required.

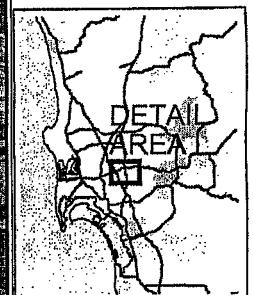
INSERT FIGURE 4-2
AERIAL PHOTO OF MISSION VALLEY AQUIFER WITH CLEAR OVERLAY

SanGIS

Water Department

LEGEND

- City Property
- General City
- Water Department
- MWWD
- Extent of MTBE Pollution (Approximate Area)
- Well Field



VICINITY MAP No Scale

Qualcomm

Table 4-2
Required Facilities[1]
Mission Valley Groundwater Desalter Project

Project Element	Parameter	Description
Groundwater Wells	Number of Production Wells	3[2] (2 operational, one standby)
	Well Diameter	16 inches[2]
	Well Production Rate	750 gpm[2]
	Well Pump Horsepower	30 hp (each)
	Well Depth	120 feet
Monitoring Wells	No. Monitoring Piezometers	4[3]
	Piezometer diameter	2 inches[3]
	Piezometer depth	75 feet[3]
Groundwater Conveyance	Well Conveyance Mains	Approx 2000 linear feet of 8" diameter pressure main[4]
Groundwater Treatment	Pretreatment	Cartridge filtration[4] (2.0 mgd capacity) Chemical addition (acid for pH adjustment and antiscalant)[5]
	Demineralization Treatment	Reverse osmosis membrane filtration[6] (2.0 mgd capacity; 1.8 mgd operational, 0.2 mgd standby)
	Post Treatment	Chemical addition (pH adjustment and anticorrosion)[7] Disinfection (1.8 mgd capacity)
Brine Disposal	Conveyance Main	300 lin. feet of 10" diameter gravity main[8]
Potable Water	Annual Potable Water Production Rate	1.76 mgd[9] (1,970 AFY)
	Potable Water Conveyance	260 horsepower booster pump station[10] 1000 lin.ft. of 12" dia. pressure main w/appurtenances

1 Detailed engineering studies will be required to site, size, and assess required groundwater wells, treatment facilities, and conveyance facilities. The above concept-level facilities are likely representative of the type of engineered facilities required to implement the proposed MVGDP.

2 As discussed in Chapter 2, well production rates in excess of 1000 gpm have been reported in Mission Valley. It is anticipated that production rates of 750 gpm or more will be attainable for the proposed desalination project. At this production rate, two wells would be capable of providing the 2.0 mgd inflow to the groundwater treatment facility. A third well is recommended for standby purposes and for operational rotation.

3 Small diameter monitoring piezometers would be required to assess effects of pumping on groundwater levels near the San Diego River channel and in areas where sensitive habitat occurs.

4 Length of groundwater transmission mains will depend on exact siting locations for groundwater supply wells and the MVGDP treatment plant. The 2000 linear foot estimate based on a MVGDP treatment plant site near the west end of the City-owned stadium site, one production well near the treatment plant, and two production wells spread out within stadium parking lot.

5 2.0 mgd of cartridge filtration and antiscalant addition will be required to protect reverse osmosis membranes and insure optimum operation of membrane processes. Depending on the type of selected reverse osmosis membrane, pH adjustment may also be required. Additional pre-treatment for iron and manganese removal may be required if groundwater testing shows inhibiting concentrations of iron and manganese.

6 Required reverse osmosis treatment capacity (see Table 4-3 on page 4-7) will depend on groundwater TDS, but a capacity of 2.0 mgd (approximately 1.8 mgd with 10% reserve) would be required for the maximum anticipated groundwater TDS of 2000 mg/l.

7 Post-treatment processes would include pH adjustment, chemical addition for corrosion control, and disinfection. Detailed engineering studies will be required to identify the appropriate means of disinfection, but chlorination using sodium hypochlorite could achieve desired disinfection and chlorine residual goals without creating safety hazard concerns.

8 Brine disposal conveyance facilities will depend on final selected groundwater treatment plant site. For planning purposes, gravity flow from treatment plant site to North Mission Valley Interceptor is assumed (no brine pumping). Estimate of 300 linear feet is based on groundwater treatment plant site at the southwest end of City-owned Qualcomm Stadium site adjacent to the interceptor.

9 Potable water production rate (see Table 4-3) will depend on groundwater TDS. A potable water production capacity ranging from 1.82 mgd to 1.74 mgd is projected for the anticipated range of Mission Valley groundwater TDS concentrations. At a groundwater TDS concentration of 1500 mg/l, potable water production would be 1.76 mgd.

10 Pump station horsepower estimate based on 1.76 mgd product water flow, 20 feet of static lift, 200 psi pressure requirement at Alvarado Pipeline No. 2, 1000 foot-length of 12-inch-diameter connection pipeline with a Hazen-Williams friction coefficient of 120, 90 percent motor efficiency, and 85% pump efficiency. Total required horsepower for these estimated conditions is 195 hp. Four 65 hp pumps are recommended to provide 3 duty and 1 standby unit.

Groundwater well pumps would pump extracted groundwater directly to the MVGDP treatment facility. Well pump motors of 30 horsepower (hp) each should be sufficient to pump against anticipated well drawdowns.

Groundwater Conveyance Facilities. Required groundwater conveyance facilities will be dependent on well distances from the MVGDP treatment facility. It is anticipated that one well will be located at or near the desalter plant site. For preliminary planning purposes, it is estimated that approximately 2000 linear feet of 8 inch pressure main would be required for conveying groundwater from production wells to the MVGDP treatment facility.

4.3 Groundwater Treatment

Treatment processes and operations at the MVGDP treatment plant will depend on the quality of the groundwater supply. Figure 4-1 (page 4-2) presents anticipated MVGDP treatment operations at a groundwater TDS concentration of 1500 mg/l. To achieve a target potable water TDS concentration of 500 mg/l, it is anticipated that reverse osmosis treatment will be required for approximately 1.76 mgd of the total 2.0 mgd groundwater flow. If Mission Valley groundwater TDS concentrations are higher than 1500 mg/l, a greater percentage of the withdrawn groundwater will require demineralization treatment.

Table 4-3 (page 4-7) presents a breakdown of the MVGDP treatment process flow streams for a range of potential groundwater TDS concentrations. At a influent TDS concentration of 2000 mg/l (considered worst case, since groundwater TDS concentrations may improve with implementation of MVGDP), it will be necessary to direct 1.74 mgd of the 2.0 mgd groundwater flow through the reverse osmosis units. To handle such an influent TDS concentrations, 2.0 mgd of reverse osmosis treatment capacity is recommended. (This would allow 10 percent of membranes to be down at any time for maintenance while maintaining full plant production capacity.)

Pretreatment Facilities. Pretreatment (2.0 mgd capacity) will be required prior to reverse osmosis membrane filtration. Pretreatment process needs will depend on the quality of the influent groundwater flow and the type of reverse osmosis membrane selected. For initial planning purposes, it is anticipated that pretreatment needs would include:

> *Cartridge Filtration.* Filtration effects associated with the groundwater aquifer should insure that particulate matter in the treatment plant influent is minimal. Cartridge filtration, however, is recommended to insure adequate removal of particulate matter in the reverse osmosis influent stream.
>
> *Chemical Addition.* Acid addition may be required for pH adjustment, depending on the type of reverse osmosis membrane selected for use. (Some reverse osmosis membranes, such as cellulose acetate membranes, work best at a low pH. If polyamide membranes are selected for use, pH adjustment may not be required.) Antiscalant would be added to the reverse osmosis inflow to protect the membranes and optimize membrane performance.

As previously noted, historical data do not indicate the need for iron and manganese treatment as part of the MVGDP treatment system. Analysis of current groundwater quality, however, will be required to confirm that iron and manganese do not result in reverse osmosis membrane inhibition or noncompliance with DHS secondary drinking water standards.

Reverse Osmosis Treatment. Reverse osmosis treatment facilities consist of pressure pumps and racks of pressure vessels that contain reverse osmosis membranes. Engineering studies will be required to select appropriate reverse osmosis membranes. Significant advances in membrane technology have occurred in recent years. Current state-of-the-art reverse osmosis membranes operate under pump pressures of approximately 145 psi. Membrane rejection percentages will depend on the type of membrane selected, but it is anticipated that an overall TDS rejection of approximately 90 percent can be achieved. Percent recovery is estimated at approximately 85 percent (15 percent of the flow becomes waste brine that contains 90 percent of the TDS mass).

Table 4-3
Dependence of Reverse Osmosis Treatment Flows on Mission Valley Groundwater TDS

Parameter	Groundwater TDS of 1000 mg/l	Groundwater TDS of 1500 mg/l	Groundwater TDS of 2000 mg/l
Groundwater pumping rate	2.00 mgd	2.00 mgd	2.00 mgd
Flow bypassed around reverse osmosis treatment train[1]	0.79 mgd	0.43 mgd	0.26 mgd
Inflow into reverse osmosis treatment train[1]	1.21 mgd	1.57 mgd	1.74 mgd
Waste brine flow[1]	0.18 mgd	0.24 mgd	0.26 mgd
Reverse osmosis product flow[1]	1.03 mgd	1.33 mgd	1.48 mgd
Potable Water Production[1]	1.82 mgd	1.76 mgd	1.74 mgd
Potable Water TDS	500 mg/l	500 mg/l	500 mg/l
Waste Brine TDS[1]	6000 mg/l	9000 mg/l	12,000 mg/l

1 See Figure 4-1 for a schematic of the proposed treatment train. Membrane removal percentages and recovery rates will depend on the type and manufacturer of the selected reverse osmosis membrane. Detailed engineering studies will be required to select membrane type and performance parameters. The above estimates are based a target potable water TDS concentration of 500 mg/l and the use of low pressure composite polyamide membranes that achieve 90 percent TDS removal and 85 percent recovery.

Post-Treatment. Reverse osmosis permeate will be blended with the reverse osmosis bypass flow prior to post-treatment. (See Figure 4-1 on page 4-2.) Required post-treatment includes

- pH adjustment (if required as part of reverse osmosis pretreatment),
- chemical addition, and
- disinfection.

Post-treatment chemical addition (e.g. sodium hydroxide) may be required for corrosion stability. Post-treatment pH adjustment will also be required if pretreatment pH adjustment is necessary. (If polyamide reverse osmosis membranes are selected for use in the MVGDP treatment train, pre- and post-treatment pH adjustment may not be required.)

Additional engineering analysis of disinfection alternatives will be required to identify a means of disinfection that protects consumer health and is chemically consistent with other water supplies in the City of San Diego water supply system. For planning purposes, it is assumed that sodium hypochlorite is an appropriate disinfectant. (Chlorine gas disinfection is not recommended to avoid public safety hazards at the MVGDP treatment site.)

Treatment Plant Site. As noted, a siting study will be required for locating the MVGDP treatment facility. For preliminary planning purposes, Figure 4-2 (page 4-4) presents a possible location for the facility.

MVGDP treatment facilities will be compact, and could be situated within a two acre site. Required facilities located within the fenced and secure site would include:

- roads, parking, and truck access,
- operations office,
- approximately 4000 square foot industrial-type building with concrete floor that contains reverse osmosis treatment pumps and pressure vessels,
- concrete lined chemical storage area, and
- product water booster pump station.

Demonstrating the compact nature of a 2 mgd groundwater demineralization facility, Figure 4-3 (page 4-9) presents a photograph of the original 2.0 mgd City of Oceanside brackish groundwater desalting facility.

Brine Disposal. Brine TDS concentrations and brine flows would depend on the influent groundwater supply and the type of reverse osmosis membrane selected. As shown in Table 4-3, it is anticipated that MVGDP reverse osmosis facilities would generate waste brine flows of approximately 0.24 mgd. Waste brine TDS concentrations are expected to be in the range of 6,000 – 12,000 mg/l.

Waste brine concentrations significantly exceed CRWQCB standards for ground and surface waters within Mission Valley. As a result, discharging MVGDP waste brine to a storm drain or surface water is not feasible. Sewer disposal of waste brine, however, is feasible, as (1) significant sewer disposal capacity exists within the nearby North Mission Valley Interceptor, and (2) no water reclamation plants (which would be sensitive to salt concentrations) exist downstream from the Qualcomm Stadium site. MVGDP waste brine would be discharged to the North Mission Valley Interceptor for disposal in the Pacific Ocean via the Point Loma treatment plant. Required brine conveyance facilities would depend on the location of the MVGDP treatment plant site. It is probable that brine pumping will not be required. For preliminary planning purposes, it is estimated that approximately 300 feet of 10-inch-diameter gravity main would be adequate for transporting MVGDP brine to the North Mission Valley Interceptor that parallels the San Diego River at the south portion of the Qualcomm Stadium site.

Figure 4-3 City of Oceanside 2.0 mgd Brackish Groundwater Desalting Facility
1995 Photo (Prior to expansion to 6.37 mgd capacity)

Potable Water Delivery Facilities. As noted in Section 3.4, potable water mains exist in the Qualcomm Stadium vicinity that are sufficiently large to receive MVGDP product water flows. The 48-inch-diameter Alvarado Pipeline No. 2 is situated within the northern portion of the Qualcomm Stadium site approximately parallel to Friars Road. Alvarado Pipeline No. 2 is in the City's 536 pressure zone.

As a result of the size and location of Alvarado Pipeline No. 2, no offsite potable water conveyance facilities would be required if MVGDP facilities are constructed within the Qualcomm Stadium site. Potable water would be conveyed from MVGDP to the Alvarado Pipeline No. 2 via a booster pump station at the MVGDP site and a conveyance main.

Required pump station and conveyance main characteristics will depend on MVGDP site selection and the location of the tie-in with Alvarado Pipeline No. 2. For preliminary planning purposes, it is estimated that a booster pump station with four 65-horsepower pumps (three operational and one standby) and 1000 linear feet of 12-inch-diameter high pressure force main would be required to boost 1.76 mgd of MVGDP potable supply to the 536 pressure zone of Alvarado Pipeline No. 2.

5.0 *Implementation Considerations*

5.1 Implementation Overview

The implementation of successful local groundwater demineralization projects by the City of Oceanside and Sweetwater Authority demonstrate the overall feasibility of developing potable water supplies from San Diego area-brackish groundwaters. Similar to the City of Oceanside and SWA projects, Mission Valley offers a number of advantages to groundwater supply development through groundwater demineralization, including:

- favorable hydrogeologic circumstances such as high well yields, abundant groundwater recharge, and adequate year-round and dry-season surface water flows within the San Diego River,
- an underutilized aquifer to which the City of San Diego has overlying land ownership, and
- an available large and centrally-located City-owned site with significant utility assets (water system, sewer system, and electrical grid) already in place.

Development of the MVGDP concept presented herein would be consistent with the City's Long Range Water Resources Plan, and would be consistent with water development plans established by MWD and SDCWA.

Implementation of MVGDP can be achieved within the 2010 "near term" time frame established by the Water Department. To achieve this implementation goal, however, progress in a number of areas will be required over the next few years. This chapter addresses "concept-level" project costs, identifies key required regulatory issues and other MVGDP implementation issues that require resolution, and presents a time schedule to achieve MVGDP implementation by 2010.

5.2 Project Costs

Capital Costs. Detailed engineering studies will be required to identify and assess capital and operation and maintenance costs for proposed MVGDP facilities. Table 5-1 (page 5-2) presents an opinion of "concept level" capital costs for the project as it is currently envisioned.

Table 5-1
Concept-Level Probable Construction Costs
Mission Valley Groundwater Desalter Project

Category	Facility	"Concept-Level" Probable Construction Cost[1]
Groundwater Withdrawal	Land acquisition	0[2]
	Three 16-inch cased diameter, 120-foot deep production wells with pumps and well-head facilities (includes well development)	540,000
	Four 4-inch diameter 75 foot-deep cased monitoring piezometers	10,000
Groundwater Conveyance	2000 linear feet of 8 inch pressure main and appurtenances (includes repaving)	120,000[3]
Treatment facilities	Land acquisition	0[1]
	Sitework & buildings	750,000
	Treatment facilities: a) 2.0 mgd pretreatment capacity including cartridge filtration & chemical addition b) 2.0 mgd capacity reverse osmosis treatment c) Post-treatment, including disinfection and pH adjustment d) Chemical storage	2,800,000
Brine disposal conveyance	Sewer system capacity charge	2,150,000[4]
	300 linear feet of 10" diameter brine line (includes connection to North Mission Valley Interceptor and repaving)	30,000[3]
Potable Water Conveyance	1000 linear feet 12"-diameter pressure main (includes repaving)	90,000[3]
	260 hp (four 65 hp pumps/motors) pump station	500,000
SUBTOTAL		$7,000,000
Planning, regulatory, environmental, permits (Estimated at approximately 10% of construction subtotal, excluding sewer capacity charge)		500,000
Administration, legal, geotechnical, engineering, construction management (Estimated at 25% of construction subtotal, excluding sewer capacity charge)		1,200,000
Contingencies (Estimated at 25% of construction subtotal, excluding sewer capacity charge)		1,200,000
"CONCEPT-LEVEL" PROBABLE CAPITAL COSTS AT ENR 7500		$9,900,000

1 Based on ENR Construction Cost Index of 7500. (ENR Construction Cost index is approximately 7000 in April 2004.)
2 Assumes use of existing City of San Diego Qualcomm Stadium site for wells, pipelines, and groundwater treatment plant site. Assumes no land acquisition charges to the City of San Diego Water Department associated with use of the site.
3 Assumes no right-of-way costs associated with placing pipelines within the Qualcomm Stadium parking lot and site.
4 Based on standard Metro System capacity charge of $2500 per equivalent dwelling unit.

"Concept level" capital costs presented in Table 5-1 are, in part, based on costs associated with similar groundwater desalter operations implemented within Southern California. "Concept level" capital costs presented in Table 5-1 are also based on:

- the use of existing City-owned sites for groundwater wells and the treatment facility, with no land acquisition or rights-of-way costs to the Water Department,
- an Engineering News Record (ENR) Construction Cost Index of 7500,
- no need for iron and manganese pretreatment,
- cleanup of the existing Mission Valley Terminal hydrocarbon and MTBE spill by year 2010, with sufficient cleanup progress being achieved by 2005 to satisfy DHS source water concerns and allow the City Council to approve and fund required project development tasks,
- planning, regulatory, environmental, and permitting costs at 10 percent of the "concept level" construction cost (which excludes sewer capacity charges),
- administration, legal, engineering, geotechnical, and construction management costs at 25 percent of the "concept level" construction cost, and
- contingencies at 25 percent of the "concept level" construction cost.

A "concept level" capital cost of \$9.9 million is estimated on the basis of previously-noted MVGDP planning assumptions and proposed facilities. As noted, this "concept level" capital cost estimate includes a 60% add-on for construction contingencies and program costs such as geotechnical, environmental, administration, legal, engineering, and construction management.

As shown in Table 5-1, approximately 22 percent (\$2.15 million) of the \$9.9 million capital cost is for Metropolitan Sewer System (Metro System) "capacity charges" for securing 0.24 mgd of capacity in the North Mission Valley Interceptor for brine disposal.

Operation and Maintenance Costs. Table 5-2 (page 5-4) presents "concept level" annual operation and maintenance (O&M) costs for the proposed MVGDP groundwater desalting operation. As shown in Table 5-2, total annual O&M costs are estimated at approximately \$1.3 million per year.

Assuming the Water Department is charged the standard Metro System sewer discharge rate of \$2.73 per 100 cubic feet for disposing of waste brine in the Metro System, approximately 25 percent (\$0.32 million) of this annual \$1.3 million O&M cost would be for sewer discharge fees.

Table 5-2
Concept-Level Probable Operation and Maintenance Costs
Mission Valley Groundwater Desalter Project

Category	Facility	"Concept-Level" Annual Probable O&M Cost[1]
Groundwater Withdrawal	Well pumping	30,000[2]
	Well maintenance	10,000
Groundwater Conveyance	Conveyance line maintenance	1,000[3]
Treatment facilities	Treatment facilities operation and maintenance	670,000[4]
Brine disposal conveyance	Metro System sewer disposal charges	320,000[5]
	Brine line maintenance	1,000[3]
Potable Water Conveyance	Pressure main maintenance	1,000[3]
	Pump station pumping	160,000[6]
	Pump station maintenance	40,000[7]
Water quality monitoring/regulatory compliance		80,000
"CONCEPT-LEVEL" PROBABLE ANNUAL O&M COSTS		$1,300,000[8]

1 Based on ENR Construction Cost Index of 7500. Values rounded to two significant figures. (ENR Construction Cost index is approximately 7000 in April 2004.)
2 Assumes 90 percent motor efficiency, 85 percent pump efficiency, 75 foot lift, and 12 cents per kilowatt hour power cost.
3 Maintenance for pipelines assumed at 1 percent of construction cost.
4 Based on low pressure (145 psi) membranes and 12 cents per kilowatt hour power cost. Estimate includes chemical addition, membrane replacement, and staff costs.
5 Assumes a Metro System sewer service charge of $2.733 per 100 cubic feet ($0.0037 per gallon) for the 0.24 mgd brine flow.
6 Assumes 90 percent motor efficiency, 85 percent pump efficiency, 485 foot total dynamic lift into Alvarado Pipeline No. 2 (536 pressure zone), and 12 cents per kilowatt hour power cost.
7 Annual pump station maintenance/repair costs estimated at approximately 8 percent of construction costs.
8 Sum of annual estimated O&M costs rounded to two significant figures.

Unit Project Costs. MVGDP project costs can, in part, be mitigated by available financial incentives. To mitigate against future imported water supply uncertainty, the MWD Local Resources Program provides (through a competitive process) qualifying MWD member agencies with financial assistance of up to $250 per AF of developed local groundwater supply. The incentive is provided by MWD for terms of up to 25 years.

Table 5-3 (page 5-5) shows that the projected MVGDP unit water supply development cost without the MWD financial assistance is approximately $1,070/AF. To demonstrate the range of possible unit MVGDP water costs, Table 5-3 also presents the case in which the City qualifies for the maximum $250/AF MWD assistance. As shown in Table 5-3, a unit MVGDP water development cost of $820/AF is projected if the Water Department secures the maximum available MWD $250/AF incentive. Approximately 30 percent of this unit cost ($250/AF) is associated with Metro System sewer disposal capacity charges and waste brine disposal fees.

The estimated MVGDP unit cost is higher than estimated unit water development costs for the City of Oceanside and SWA groundwater desalting projects. Brine disposal is the prime reason for the cost differences between MVGDP and the Oceanside and SWA projects. The City of Oceanside Utilities Department, operates Oceanside's water and sewer systems, and does not charge itself for discharging waste brine to the sewer. SWA discharges waste brine to a storm drain in accordance with a NPDES (National Pollutant Discharge Elimination System) permit issued by CRWQCB. (As previously noted, a brine discharge to Mission Valley storm drains or surface waters would not feasible either from a regulatory or environmental standpoint.)

In addition to brine disposal costs, the City of Oceanside and SWA projects are larger in capacity than the conceptual MVGDP, which provides economy of scale savings for site structures, pretreatment facilities, post-treatment facilities, and chemical storage.

Table 5-3
Concept-Level Probable Unit Water Development Costs
Mission Valley Groundwater Desalter Project

Category	"Concept-Level" Probable Unit Water Development Cost[1]
"Concept Level" Probable Annual O&M Costs[2]	$1,300,000
Annualized "Concept Level" Probable Capital Costs[3]	$800,000
Total "Concept-Level" Annual Cost[4]	$2,100,000
Acre-feet per year of annual water production	1,970 AF
Projected Unit Cost for Developed Water Supply[5]	$1,070/AF[6]
Potential MWD Local Resources Program Assistance[7]	$250/AF[7]
Projected Unit Costs with MWD $250/AF Subsidy	$820/AF[8]

1 Based on ENR Construction Cost Index of 7500. Values rounded to two significant figures. (ENR Construction Cost Index is approximately 7000 in April 2004.)
2 From Table 5-2 (page 5-4).
3 Capital costs from Table 5-1 (page 5-2) annualized over 20 year period using 5% discount rate. Values rounded to two significant figures.
4 Sum of annual O&M costs and annualized capital costs, rounded to two significant figures.
5 Total annual costs divided by number of AFY of water supply production. Rounded to nearest $10/AF.
6 Approximately $250/AFY of this $1070/AF costs (23 percent) is for the purchase of Metro System sewer capacity and for annual Metro System sewer discharge fees for the 0.24 mgd brine discharge.
7 To mitigate against future imported water supply uncertainty, through a competitive process the MWD Local Resources Program provides qualifying MWD member agencies with financial assistance of up to $250 per AF of developed local groundwater supply. For qualifying agencies, the incentive is provided by MWD for terms of up to 25 years. To show the potential range of water development costs, the above table provides unit costs with no MWD financial incentive, and unit costs assuming the City of San Diego qualifies for the maximum $250/AF incentive.
8 Approximately $250/AFY of this $820/AF cost (30 percent) is for the purchase of Metro System capacity and for annual sewer discharge fees for the 0.24 mgd brine discharge.

5.3 Required Regulatory Approvals

DHS Requirements. Drinking water supplies developed by the proposed MVGDP would be regulated by DHS through the issuance of a water supply permit. DHS will require that concentrations within the treated water supply conform to state and federal drinking water standards. Additionally, DHS will require conformance with state and federal surface water treatment regulations. State and federal surface water treatment regulations require treatment and disinfection of groundwaters "under the influence" of surface waters. In the *California Code of Regulations*, groundwaters under the influence of surface waters are defined as:

> any water beneath the surface of the ground with significant occurrence of insects or other macroorganisms, algae or large diameter pathogens such as Giardia lamblia, or significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions.

The state and federal surface water treatment regulations require water purveyors to provide a four logarithm (99.99 percent or 10^4) reduction of virus, and a three logarithm (99.9% or 10^3) reduction in Giardia cysts. To comply with surface water treatment regulations, it will be necessary to either:

- demonstrate through water quality testing that constructed Mission Valley groundwater wells provide the required degree of virus and Giardia reduction through streamflow infiltration and the percolation of groundwater through the soil prior, or
- insure that 100 percent of withdrawn groundwater receives the equivalent to filtration treatment (including the portion of pumped groundwater that bypasses reverse osmosis treatment).

Fish and Wildlife Regulation. California Department of Fish and Game (DFG) and the U.S. Fish and Wildlife Service (USFWS) are involved in reviewing groundwater supply projects through the CEQA process, and through powers established in state and federal endangered species legislation. The wildlife agencies have authority to require mitigation on projects that may impact sensitive habitat. The U.S. Fish and Wildlife Service also has wide-ranging police powers to enforce the federal Endangered Species Act. Aspects of the proposed Mission Valley brackish groundwater desalting project that would be reviewed by DFG and USFWS include:

- construction of facilities,
- impacts to surface water flow or aquatic habitat that may result from groundwater pumping, and
- impacts on groundwater-dependent habitat that may result from groundwater drawdowns associated with pumping.

Given the high porosity of the Mission Valley aquifer and the known relation between surface waters and groundwater, the sizing and siting of Mission Valley groundwater production wells will be critical to insuring DFG and USFWS approval.

5.4 Potential Implementation Obstacles

Table 5-4 (page 5-8) presents a list of unresolved implementation issues that require resolution in order to (1) secure regulatory agency approval, and (2) move forward with implementation of MVGDP. As shown in Table 5-4, key unresolved implementation issues include:

- insuring cleanup of the Mission Valley Terminal hydrocarbon and MTBE spill in a timely manner,
- determining if iron and manganese treatment is required,
- identifying brine disposal costs,
- securing the maximum amount of the potential MWD $250/AF groundwater development incentive,
- refining facilities needs and costs,
- siting proposed facilities,
- coordinating with DHS to address surface water treatment concerns, and
- completing environmental and geotechnical analyses to confirm that MVGDP groundwater pumping will not discernibly affect groundwater table elevations in sensitive areas or affect surface flow in the San Diego River

5.5 Required Action Items and Potential Implementation Schedule

Table 5-5 (page 5-9) presents a list of action items required to refine the MVGDP concept and address unresolved implementation issues. Table 5-5 also presents the potential project implementation schedule for action items required to implement MVGDP. As shown in Table 5-5, implementation of MVGDP can be achieved by year 2010.

Table 5-4
Implementation Issues Requiring Resolution
Mission Valley Groundwater Desalter Project

Category	Issue Requiring Resolution
Water Quality	• Confirm absence of groundwater quality constituents (iron, manganese, etc.) that may inhibit operation of reverse osmosis membrane treatment • Confirm TDS and mineral breakdown of groundwater quality • Determine if the Mission Valley Terminal MTBE and hydrocarbon plume will affect the required degree of treatment or demineralization
Regulatory	• Determine if surface water treatment compliance issues will affect required treatment facilities • Determine effects of Mission Valley Terminal MTBE and hydrocarbon plume on DHS requirements and approval
Engineering	• Determine if Qualcomm Stadium sites are available for siting wells, treatment facility, and pipelines • Identify type of filtration membranes appropriate for the proposed quality of supply • Confirm/identify required pre- and post-treatment processes, including appropriate means of disinfection
Geotechnical	• Confirm/identify aquifer characteristics, well yields, and projected drawdowns • Identify well sites to minimize adverse environmental effects
Environmental	• Confirm that well pumping will not adversely affect river hydraulics or aquatic habitat • Confirm that well pumping will not adversely affect groundwater-dependent vegetation • Select appropriate locations for monitoring wells
Costs/Funding	• Determine availability of MWD $250/AF financial incentive • Evaluate brine disposal capacity charges and disposal fees with Metropolitan Wastewater Department • Finalize proposed project costs and secure source of funding

Table 5-5
Proposed Action Items and Implementation Schedule
Mission Valley Groundwater Desalter Project

Year	Task
2004	• Initial concept planning study and evaluation of project concept • Assessment of MTBE plume impacts on project feasibility • Assess and finalize brine disposal costs with Metropolitan Wastewater Department • Water Department review and approval of project concept
2005	• Water Department groundwater treatment plant site selection review • City Council approval and funding of feasibility confirmation studies, predesign, and environmental review • Select contractors for feasibility confirmation studies, geotechnical evaluation, predesign, and environmental review • Initiate preliminary geotechnical studies, groundwater testing program, surface water treatment compliance assessment, and predesign • Initiate environmental review and coordinate with DFG and USFWS
2006	• Finalization/confirmation of project predesign, finalize site selection, finalize cost estimates, and prepare preliminary engineering facilities report • Prepare and submit MWD application for $250/AF financial assistance • Water Department finalization of proposed project funding • City Council approval and funding commitment for design/construction • Initiate facilities design
2007	• Complete CEQA certification and finalize facilities design • Advertise/bid award for construction
2008	• Initiate facilities construction
2009	• Complete well construction, well development, and initial well testing
2010	• Complete construction of treatment and conveyance facilities • Initial treatment facilities start-up, operator training and facilities testing • Full production; secure DHS Water Supply Permit

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